# Gastrotricha Mečnikow, 1865 from Copenhagen Palm House – contribution to the knowledge of *Lepidodermella intermedia* Kånneby, Todaro & Jondelius, 2012 (Chaetonotida, Gastrotricha)

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**ABSTRACT**
Gastrotricha Mečnikow, 1865 compose a cosmopolitan phylum of aquatic and semi-aquatic invertebrates comprising over 850 described species, that are known to inhabit various aquatic ecosystems from all over the world where they often show high density and diversity. Up to now Gastrotricha have been studied in artificial habitats, such as greenhouses only in the Poznań Palm House (Poland). In May 2013 a preliminary study was conducted in the Copenhagen Palm House (Denmark) to provide additional evidence of the presence of gastrotrichs in anthropogenic water bodies in greenhouses. Five species were found: *Ichthydium podura* Müller, 1773, *Lepidodermella intermedia* Kånneby, Todaro & Jondelius, 2012, *Chaetonotus* (*Hystricochaetonotus*) *macrochaetus* Zelinka, 1889, *Chaetonotus* (*Hystricochaetonotus*) sp., and *Chaetonotus* (*Chaetonotus*) sp. *Lepidodermella intermedia* is new to Danish fauna and constitutes the second record of this species. Detailed taxonomic and morphological remarks are provided for this newly recorded species.

**KEY WORDS**
artificial habitat,
Chaetonotidae,
gastrotrichs,
greenhouse fauna,
new record.

**RÉSUMÉ**
*Les Gastrotricha* Mečnikow, 1865 *de la serre de Copenhague – contribution à la connaissance de* Lepidodermella intermedia *Kånneby, Todaro & Jondelius, 2012 (Chaetonotida, Gastrotricha).*
Les Gastrotricha Mečnikow, 1865 constituent un phylum cosmopolite d'invertébrés terrestres aquatiques et péri-aquatiques comprenant plus de 850 espèces décrites, qui habitent différents écosystèmes aquatiques dans le monde entier et qui présentent souvent une haute densité et une grande diversité. Jusqu'à maintenant, les gastrotriches ont été uniquement étudiés dans des habitats

artificiels, comme les serres du jardin botanique de Poznań (Pologne). En mai 2013, une étude préliminaire a été effectuée dans le jardin botanique de Copenhague (Danemark) afin de fournir des preuves supplémentaires de la présence de gastrotriches dans les plans d'eau anthropiques des serres. Cinq espèces y ont été trouvées : *Ichthydium podura* Müller, 1773, *Lepidodermella intermedia* Kånneby, Todaro & Jondelius, 2012, *Chaetonotus* (*Hystricochaetonotus*) *macrochaetus* Zelinka, 1889, *Chaetonotus* (*Hystricochaetonotus*) sp., et *Chaetonotus* (*Chaetonotus*) sp. *Lepidodermella intermedia* est signalée pour la première fois pour la faune danoise et cela constitue la deuxième signalisation de l'espèce. Des observations taxonomiques et morphologiques détaillées sont fournies pour cette espèce.

**MOTS CLÉS**
habitat artificiel,
Chaetonotidae,
Gastrotriches,
faune à effet de serre,
signalisation nouvelle.

## INTRODUCTION

Gastrotricha Mečnikow, 1865 is a taxon of monophyletic, microscopic, acoelomate metazoans ranging from 50 µm to 3500 µm in body length (Kisielewski 1997; Hochberg & Litvaitis 2000; Todaro *et al.* 2006). Hitherto, *c.* 850 nominal species of Gastrotricha divided into two orders (Chaetonotida Remane, 1925 [Rao & Clausen, 1970] and Macrodasyida Remane, 1925) have been described (Todaro 2014). They inhabit aquatic (marine as well as freshwater) and wet terrestrial ecosystems (peat-bogs, alder woods, riparian forests, etc.) (Kisielewski 1997; Balsamo *et al.* 2013). Gastrotricha constitute a significant component of benthic, psammic and epiphytic ecosystems (e.g., Nesteruk 1996, 2004; Balsamo & Todaro 2002; Balsamo *et al.* 2008). The main factors accounting for our poor knowledge of these animals are methodological problems (e.g., collecting, extracting, preserving and determining) (Balsamo *et al.* 2008) and the low number of taxonomic specialists of this group. Despite their abundance in various habitats, gastrotrichs are often omitted in faunistic studies or, very often, mentioned only as a group, without identification to species level (e.g., Kotwicki *et al.* 2005; Fonseca *et al.* 2011).

Europe is the best known continent as concerns the presence and distribution of freshwater Gastrotricha, but knowledge about different countries is very heterogeneous, e.g., 99 species are known from Poland, whereas no freshwater gastrotrich species has been recorded from the Netherlands or Portugal (excluding Azores) (Balsamo *et al.* 2008; Kolicka *et al.* 2013). Freshwater gastrotrich fauna from Denmark is still poorly known. Hitherto, only 27 species have been found, and no specific research on gastrotrich fauna present in anthropogenic structures has been carried out yet (Grilli *et al.* 2010).

Palm houses, which are the site of exposure of exotic plants from around the world, can create convenient conditions for many introduced invertebrate species and can be considered as inland islands (e.g., Zawierucha *et al.* 2013). Although aquatic fauna in greenhouses have been studied by several researchers (e.g., Lankester 1880; Scourfield 1897; Reid 2001; Duggan & Duggan 2011), gastrotrichs have only been studied at the Poznań Palm House (Poland) (Kolicka *et al.* 2013). These studies have shown that those artificial conditions generate appropriate conditions for a rich Gastrotricha fauna composed of 13 species, including a new subgenus and three new species.

The purpose of this study is to increase the knowledge of Gastrotricha inhabiting artificial habitats such as greenhouses.

## MATERIAL AND METHODS

### Study site

Sediment was collected from the Copenhagen Palm House (the largest greenhouse in the Botanical Garden of Copenhagen University). The Copenhagen Palm House is one of the oldest of such structures in the world with an area of 2400 m$^2$. It was established between 1872 and 1874 and underwent thorough repairs between 1980 and 1982.

### Methods

On 30 May 2013 were collected three sediment samples from three shallow stone reservoirs with water plants adjacent to the walls of the Palm House. Sampling was conducted by hand, and the upper sediment was put into plastic containers of 100 cm$^3$ volume. Subsequently, the samples were transported to the laboratory and thoroughly analysed for 120 hours (± 5 % time). From each site 0.5 cm$^3$ sediments were analyzed. Material was scanned for gastrotrichs under a Olympus SZ51 stereomicroscope. All gastrotrichs were extracted with a micropipette and studied alive. All specimens were observed with a Olympus BX41 microscope, photographed with an Atray Artcam 300 MI digital camera, and then measured with the QuickPhoto Camera software. All figures were prepared using Photoshop CS6. The micro-photographic documentation is deposited in Muséum national d'Histoire naturelle in Paris and in a collection of the author.

All measurements are given in micrometers (µm) and formulas (pharynx formulas, ratio of scales distribution) are given in percentages (%). Structures were measured only if their orientations were suitable. The scales and bristles were measured from the smallest or shortest to the largest or longest on the body. The obtained dimensions are expressed in ranges. Because of the very limited usefulness for taxonomic purposes, no animals were preserved. The description of new recorded species follows the convention of Hummon *et al.* (1992), where the positions of certain morphological characters are given in percentage units (U) of the total body length measured from the anterior to posterior. The identification of gastrotrichs, morphological study, formulae and indices used in the present study follows Kisielewski (1991).

## RESULTS

The presence of Gastrotricha was noted in two of the three reservoirs. In three samples a total of 21 specimens were found, belonging to five species, two genera, and one family. The following species were recorded in the Copenhagen Palm House: *Ichthydium podura* Müller, 1773 (12 specimens), *Lepidodermella intermedia* Kånneby, Todaro & Jondelius, 2012 (six specimens), *Chaetonotus* (*Hystricochaetonotus*) *macrochaetus* Zelinka, 1889 (one specimen), *C.* (*H.*) sp. (one specimen), and *C.* (*Chaetonotus*) sp. (one specimen). This record of *L. intermedia* is the second for this species and the first of the genus *Lepidodermella* Blake, 1933 in Denmark. A morphological description of this taxon together with detailed measurements of the observed specimens are given below (Table 1). In addition to Gastrotricha in the studied reservoirs such animals have been identified as: Rotifera Cuvier, 1817, Platyhelminthes Gegenbaur, 1859, Polychaeta Grube, 1850, Copepoda Milne-Edwards, 1840, Cladocera Latreille, 1829, Ostracoda Latreille, 1829 and Acari Leach, 1817.

## SYSTEMATICS

Phylum GASTROTRICHA Mečnikow, 1865
Order CHAETONOTIDA Remane, 1925
[Rao & Clausen, 1970]
Suborder PAUCITUBULATINA d'Hondt, 1971
Family Chaetonotidae Gosse, 1864
(sensu Leasi & Todaro, 2008)
Subfamily Chaetonotinae Gosse, 1864
(sensu Kisielewski, 1991)

### *Lepidodermella* Blake, 1933

Typus generis. — *Lepidodermella squamata* (Dujardin, 1841).

Terra typica. — France.

### Remarks

This polyphyletic genus (Kånneby *et al.* 2012, 2013) comprises 13 nominal freshwater species and one nominal marine species (Todaro 2014). Present in benthic, interstitial and periphytic habitats.

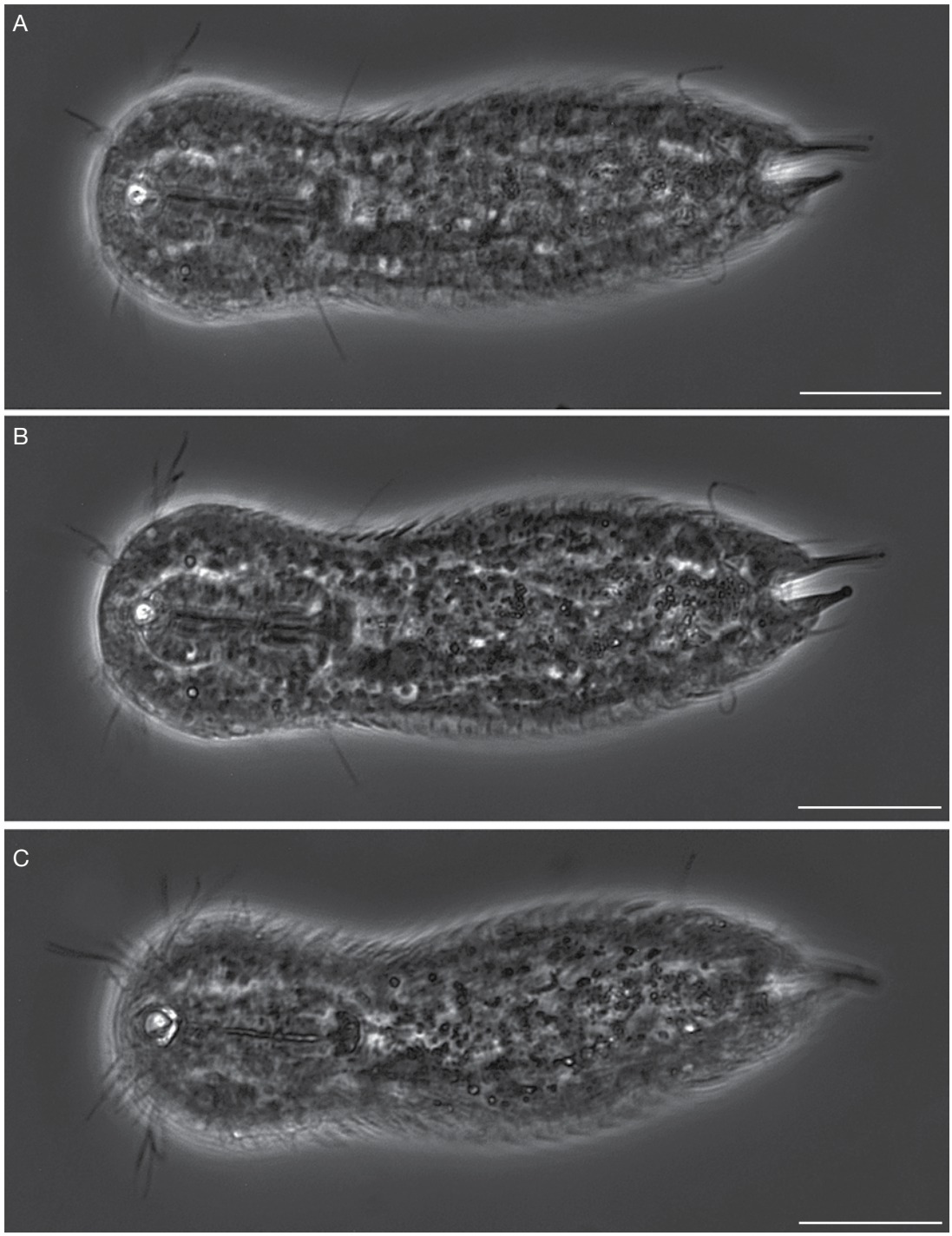


Fig. 1. — *Lepidodermella intermedia* Kånneby, Todaro & Jondelius, 2012: **A**, dorsal view; **B**, view of internal morphology; **C**, ventral view. Scale bars: 20 µm.

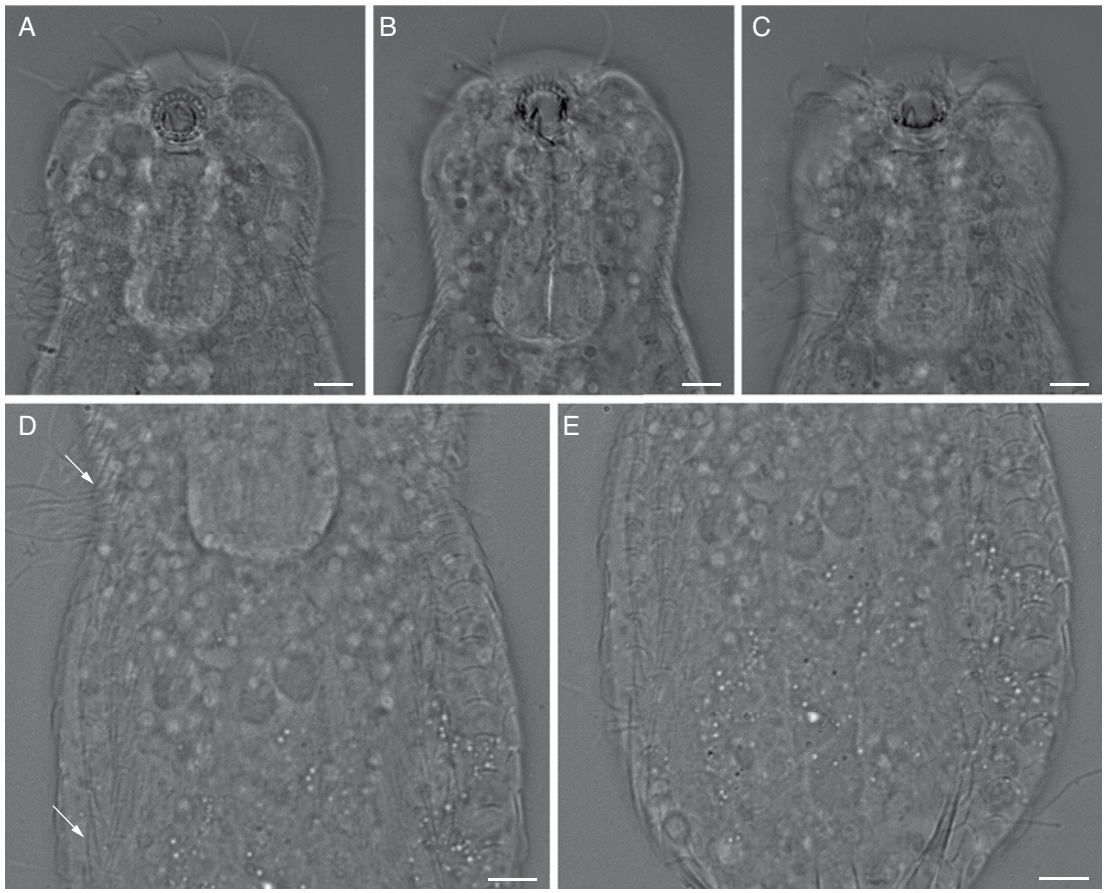


Fig. 2. — *Lepidodermella intermedia* Kånneby, Todaro & Jondelius, 2012: **A**, **B**, **C**, details of the head: the cuticular denticle in the mouth opening is visible; **D**, **E**, ventral views: ventral keeled and spined scales are visible (arrows). Scale bars: 5 µm.

***Lepidodermella intermedia***
Kånneby, Todaro & Jondelius, 2012
(Figs 1-4; Table 1)

Locality. — Copenhagen Palm House.

Material. — Six specimens (all adult), three photographed. The micro-photographs are available at the Muséum national d'Histoire naturelle in Paris and in the author's collection.

Description

*S*mall body-sized species. Body stocky; neck constriction well marked. Head weakly five-lobed semicircular; cephalion, epipleuria and hypopleuria are weakly visible in the body outline. Two pairs of cephalic ciliary tufts on the head – anterior pair (located at U4) shorter cilia than the posterior pair (located at U8). Ocellar granules absent. Mouth ring subterminal and located at U4-U7. Into the mouth a single cuticular tooth situated laterally and visible through the mouth opening. Hypostomium bowl shaped. Neck width narrower than head width. Trunk (from *c.* U34) slightly and gradually expand to about halfway down the length of the body (*c.* U59) and subsequently slightly and gradually tapering up to the furcal base (*c.* U88), relatively thin and short. Furcal branches almost parallell, the adhesive tubes curved slightly inward.

Head, neck and trunk on the dorsal, dorsolateral, lateral, ventrolateral and ventral sides covered with

TABLE 1. — Morphometric parameters for *Lepidodermella intermedia* Kånneby, Todaro & Jondelius, 2012. Abbreviations: **N**, number of specimens or structures analysed; **Range**, the smallest and the largest structure found among all specimens measured; **SD**, standard deviation. Measurements in µm ratio and formulas in %.

| Character | N | Ranges on adults specimens | SD |
|---|---|---|---|
| Body length | 3 | 112.6 – 114.3 | 0.98 |
| Pharynx length | 3 | 26.4 – 30.6 | 2.42 |
| Width of anterior pharynx thickening (a) | 3 | 8.1 – 9.6 | 0.63 |
| Width of pharynx narrowing that follows anterior thickening (n) | 3 | 8.1 – 9.6 | 0.87 |
| Width of pharynx at its middle length (m) | 3 | 9.3 – 10.1 | 0.46 |
| Width of posterior pharynx thickening (p) | 3 | 12.2 – 13.7 | 0.87 |
| Length of cephalic bristles (anterior tuft) | 3 | (6.3-7.5) – (15.1-15.4) | 0.69; 0.17 |
| Length of cephalic bristles (posterior tuft) | 3 | (13.9-15.6) – (17.9-18.2) | 0.98; 0.17 |
| Hypostomium length | 3 | 4.0 – 4.3 | 0.17 |
| Cephalion length | 3 | 6.8 – 7.4 | 0.35 |
| Cephalion width | 3 | 14.1 – 14.5 | 0.23 |
| Diameter of mouth ring | 3 | 4.9 – 5.2 | 0.17 |
| Furca length | 3 | 3.9 – 4.4 | 0.29 |
| Length of adhesive tube | 3 | 16.9 – 17.5 | 0.35 |
| Body length | 3 | 9.8 – 10.4 | 0.35 |
| Head scale length | 3 | (2.1-2.4) – (3.9-5.3) | 0.17; 0.84 |
| Head scale width | 3 | (4.2-4.4) – (5.6-6.6) | 0.12; 0.61 |
| Neck scale length | 3 | (2.3-2.7) – (3.2-3.6) | 0.23; 0.26 |
| Neck scale width | 3 | (3.5-4.0) – (4.9-5.3) | 0.29; 0.23 |
| Trunk scale length | 3 | (3.4-4.0) – (5.3-5.8) | 0.35; 0.29 |
| Trunk scale width | 3 | (5.1-5.5) – (6.7-7.5) | 0.23; 0.49 |
| Scale with sensory posterior sensory bristle length | 3 | 3.7 – 4.0 | 0.17 |
| Scale with sensory posterior sensory bristle width | 3 | 5.3 – 5.8 | 0.29 |
| Head ventral scale with spine length | 3 | (3.1-3.4) – (4.2-4.6) | 0.17 – 0.21 |
| Head ventral scale with spine width | 3 | (1.4-1.8) – (1.9-2.3) | 0.23; 0.26 |
| Neck ventral scale with spine length | 3 | (2.3-3.3) – (3.8-4.2) | 0.58; 0.26 |
| Neck ventral scale with spine width | 3 | (1.9-2.4) – (2.6-3.1) | 0.29; 0.26 |
| Trunk ventral scale with spine length | 3 | (3.7-4.4) – (4.9-5.3) | 0.40; 0.26 |
| Trunk ventral scale with spine width | 3 | (2.7-3.3) – (4.9-5.2) | 0.35; 0.21 |
| Posteriormost interciliary field scale length | 3 | 8.8 – 9.2 | 0.23 |
| Posteriormost interciliary field scale width | 3 | 3.1 – 3.6 | 0.29 |
| Neck ventrolateral spine length | 3 | (1.5-1.8) – (2.3-2.9) | 0.17; 0.35 |
| Trunk ventral spine length | 3 | (4.3-4.8) – (10.0-10.7) | 0.29; 0.38 |
| Length of posteriormost pair of lateral spine | 3 | 9.9 – 10.5 | 0.35 |
| Length of spines of posteriormost interciliary field | 3 | 4.2 – 4.9 | 0.40 |
| Anterior sensory bristles length | 3 | 13.7 – 13.9 | 0.12 |
| Posterior sensory bristles length | 3 | 14.2 – 14.6 | 0.23 |
| Number of anterior and posterior cephalic cilia in one tuft | 6 | 5; 5 | 0.00 |
| Number of separated cephalic tufts | 6 | 4 | 0.00 |
| Number of scales in single longitudinal row | 6 | 32 – 36 | 1.83 |
| Total number of longitudinal alternating rows of scales | 6 | 17 – 21 | 1.79 |
| Pharynx formula a | 3 | *37.58 – 39.39* | 1.04 |
| Pharynx formula n | 3 | *30.45 – 31.37* | 0.53 |
| Pharynx formula m | 3 | *33.01 – 35.23* | 1.28 |
| Pharynx formula p | 3 | *44.77 – 46.21* | 0.83 |
| Ratio of scale distribution | 6 | *53.1 – 55.9* | 2.60 |

scales, with an extroverted anterior edge giving the impression of a double edge. Scales arranged in 17-21 longitudinal alternating rows, 32-36 scales in each row. Scale edges overlapping. Head scales round to suboval (from *c.* U2 to *c.* U17); neck scales almost quadrangular (from *c.* U18 to *c.* U33). Dorsal trunk scales quadrangular to pentagonal with more or less rounded edges (from *c.* U34 to

*c.* U88). Near furcal base at U86, two scales with elliptical anterior edge. Two pairs of dorsal sensory bristles, the anterior ones, on the neck, anchored by papillae at U30 and the posterior ones, at the posterior trunk region, anchored by double-keeled scales at U79-U81. Ventrolateral and ventral body areas covered by scales similar in shape but smaller than those of the dorsal trunk region. Scales of the inner longitudinal alternating rows of scales (from one to three rows) closest to the ventral ciliary bands with weak keels. From the head's end in the ventral area scales' keels drawn out into thin, simple spines increasing in length towards the posterior part of the body. The two pairs of the posterior lateral scales located at U86-U87, with simple spines. The posteriormost pair located at U87, with significantly longer and wider parafurcal spines (situated on either side of the furcal base).

Pharynx area of interciliary field (from *c.* U3 to *c.* U31) naked. Intestine area (from *c.* U32 to *c.* U85) covered with round, smooth scales arranged close and next to one another and with overlapping edges; these situated in alternating rows of six-eight scales. Two pairs of ventral terminal scales at U85-U87, central pair larger. Ventral terminal scales oval, elongated with weak keels and straight spines extending posteriorly beyond the furcal indentation.

Pharynx wide with a well-developed anterior dilatation, and a posterior dilatation is wider than the anterior one. Pharynx connected via the pharyngeal intestinal junction (at U30-U31) to the straight intestine without a separate enzymatic section.

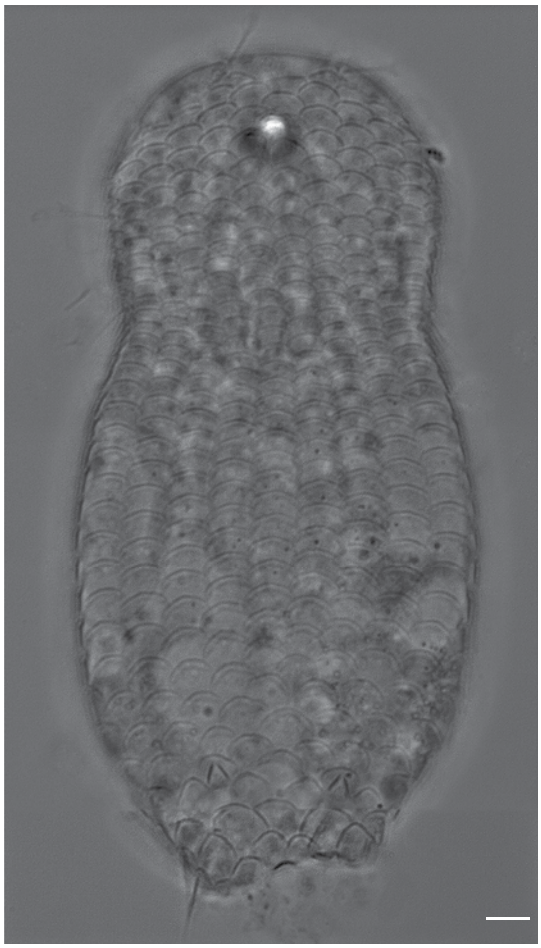

Fig. 3. — *Lepidodermella intermedia* Kånneby, Todaro & Jondelius, 2012. Dorsal view of scales. Scale bar: 5 µm.

## Remarks

The *Lepidodermella intermedia* specimens found in the Copenhagen Palm House differ from the original description in the presence of lateral and ventral spines as well as in the distribution of scales on the ventral interciliary field. The recorded specimens had spined scales along the locomotory bands from the head end boundary unlike in the original description, where the scales are described to be present only halfway down the trunk up to the end of the body. Furthermore, the Palm House specimens had two pairs of lateral spiny scales at the furcal base on the sides of the body instead of one, and the scales on the ventral interciliary field covered the entire intestinal section instead of the posterior half of the trunk as reported, in the original description. As Kisielewski (1991) stated in his description of *L. minor chaetifer* Kisielewski, 1991 the presence/lack of spines and their length may show significant variations even within a single population. Due to a lack of differences in the other taxonomic characteristics, there are no grounds to conclude that the recorded specimens represent a new, separate species. The different morphology of the recorded specimens may be the result of different living conditions (higher water temperature and a more stable

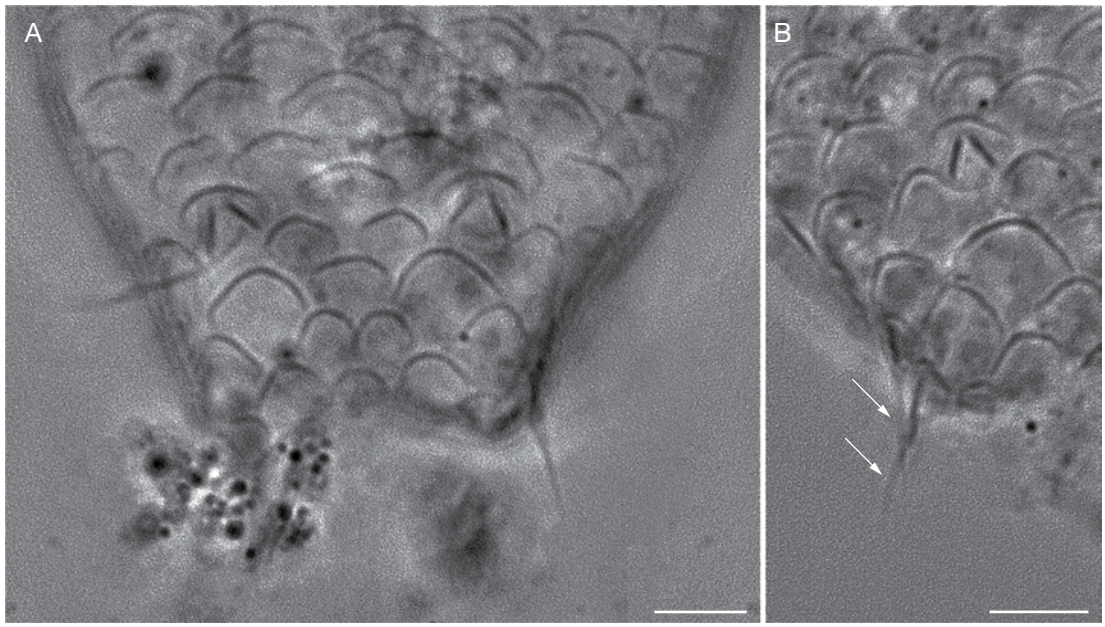


Fig. 4. — *Lepidodermella intermedia* Kånneby, Todaro & Jondelius, 2012: **A**, **B**, detail of the dorsal posterior body region: two pairs of lateral parafurcal spines are visible (arrows). Scale bars: 5 µm.

habitat) and intraspecies variability (the description of the species was based on a single specimen). However, special attention should be paid to the very strong resemblance between *L. intermedia* and *L. minor chaetifer* which likely indicates that they are extremely closely related.

### Differential diagnosis

*Lepidodermella intermedia* most closely resembles *Lepidodermella minor minor* Remane, 1936 and *Lepidodermella minor chaetifer* Kisielewski, 1991 but differs from:

*L. minor minor* in terms of: a single denticle in the mouth ring (*L. m. minor* usually has two cuticular denticles in the mouth ring, albeit the second one can be smaller and less developed vs single cuticular denticles in *L. intermedia*), a pair of lateral spined scales and ventral spined scales (no lateral and ventral scales are spined in *L. m. minor* vs some lateral and ventral scales are spined in *L. intermedia*), the shape of the terminal scales on the ventral interciliary field and the degree of coverage of the ventral interciliary field (the ventral interciliary field has only one pair of narrow ventral terminal scales and the remaining area of the ventral interciliary field is scaleless in *L. m. minor* vs two pair of eliptical ventral terminal scales and all intestine part of ventral interciliary field is covered by scales in *L. intermedia*).

*L. minor chaetifer* in terms of: the number and distribution of scales (*L. minor chaetifer* has 15-31 alternating longitudinal rows of 30-31 scales each vs 17-21 alternating longitudinal rows of 32-36 scales each in *L. intermedia*), the shape of terminal scales on the ventral interciliary field (*L. minor chaetifer* terminal scales are narrow, has rectangular shape with shallow posterior notches vs to eliptical shape of scales in *L. intermedia*), and the degree of coverage of the ventral interciliary field (the ventral interciliary field has only one pair of narrow, rectangular ventral terminal scales with a slightly curved front edge and a shallow posterior notches and the remaining area of the ventral interciliary field is scaleless in *L. minor chaetifer* vs all intestine part of intercilliary field covered by scales in *L. intermedia*).

DISTRIBUTION

Previously recorded only from the locus typicus in Sweden (Mount Njulla, Lapland) (Kånneby *et al.* 2012).

## DISCUSSION

The record of the presence of Gastrotricha in a second palm house after the first finding might demonstrate that gastrotrichs were not only accidentally dragged along into the Poznań Palm House (Kolicka *et al.* 2013), but that they really are a constant component of the fauna of these anthropogenic habitats. Gastrotricha in the form of eggs (subitaneous and resting eggs) or adult specimens in the Palm House in Copenhagen could get along with the plants that were grown in the reservoirs, their seeds or substrates, and relatively stable conditions inside the Copenhagen Palm House (e.g., lower temperature fluctuations) might allow for the survival and development of as many as five identified taxa.

Taking into account the gastrotrichs' ability for a rapid development, a short life cycle and parthenogenetic reproduction, a stable population could have been created from a small number of eggs or specimens accidentally introduced into the reservoirs (Hummon 1986; Balsamo & Todaro 1988).

This second record of *L. intermedia* shows that this species has a wider range of occurrence and some tolerance to variations of abiotic factors, such as temperature. It is possible that this species, despite its prevalence, has not yet been detected because of the small amount of research that has been carried out on Gastrotricha in general.

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## REFERENCES

BALSAMO M. & TODARO M. A. 1988. — Life history traits of two Chaetonotids (Gastrotricha) under different experimental conditions. *International Jurnal of Invertebrates Reproduction* 14: 161-176.

BALSAMO M. & TODARO M. A. 2002. — Gastrotricha, *in* RUNDLE S. D., ROBERTSON A. L & SCHMID-ARAYA J. M. (eds), *Freshwater Meiofauna*: *Biology and Ecology.* Backhuys Publishers, Leiden: 45-61.

BALSAMO M., D'HONDT J. L., KISIELEWSKI J. & PIERBONI L. 2008. — Global diversity of gastrotrichs (Gastrotricha) in freshwaters. *Hydrobiologia* 595: 85-91.

BALSAMO M., GUIDI L. & D'HONDT J. L. 2013. — Phylum Gastrotricha, *in* ZHANG Z.-Q. (ed.), Animal Biodiversity: an outline of higher-level classification and survey of taxonomic richness. *Zootaxa* 3703: 79-82.

DUGGAN I. C. & DUGGAN K. S. 2011. — Are botanical gardens a risk for zooplankton invasions? *Biological Invasions* 13 (12): 2997-3003.

FONSECA G., HUTCHINGS P. & GALLUCCI F. 2011. — Meiobenthic communities of seagrass beds (*Zostera capricornia*) and unvegetated sediments along the coast of New South Wales, Australia. *Estuarine, Coastal and Shelf Science* 91 (1): 69-77.

GRILLI P., KRISTENSEN R. M. & BALSAMO M. 2010. — Contribution to the knowledge of freshwater Gastrotricha from Denmark. *Steenstrupia* 32 (1): 79-92.

HOCHBERG R. & LITVAITIS M. K. 2000. — Phylogeny of Gastrotricha: a morphology-based framework of Gastrotricha relationships. *Biological Bulletin* 198: 299-305.

HUMMON M. R. 1986. — Reproduction and sexual development in a fresh-water Gastrotricha. 4. Life history traits and the possibility of sexual reproduction. *Transactions of the American Microscopy Society* 105 (2): 97-109.

HUMMON W. D., BALSAMO M. & TODARO M. A. 1992. — Italian marine Gastrotricha: I. Six new and one redescribed species of Chaetonotida. *Bollettino di Zoologia*, 59: 499-516.

KÅNNEBY T., TODARO M. A. & JONDELIUS U. 2012. — A phylogenetic approach to species delimitation in freshwater Gastrotricha from Sweden. *Hydrobiologia* 683: 185-202.

KÅNNEBY T., TODARO M. A. & JONDELIUS U. 2013. — Phylogeny of Chaetonotidae and other Paucitubulatina (Gastrotricha: Chaetonotida) and colonization of aquatic ecosystems. *Zoologica Scripta* 42: 88-105.

KISIELEWSKI J. 1991. — Inland-water Gastrotricha from Brazil. *Annales Zoologici* 43: 1-168.

KISIELEWSKI J. 1997. — Brzuchorzeski (Gastrotricha). Fauna Słodkowodna Polski, Zeszyt 31. *Wydawnictwo Uniwersytetu Łódzkiego*, Łódź, 157 p.

KOLICKA M., KISIELEWSKI J., NESTERUK T. & ZAWIERUCHA K. 2013. — Gastrotricha from the Poznań Palm House – one new subgenus and three new species of freshwater Chaetonotida (Gastrotricha). *Zootaxa* 3717 (2): 231-279.

KOTWICKI L., SZYMELFENIG M., DE TROCH M., URBAN-MALINGA B. & WĘSŁAWSKI J. M. 2005. — Latitudinal biodiversity patterns of meiofauna from sandy littoral beaches. *Biodiversity and Conservation* 14: 461-474.

LANKESTER E. R. 1880. — On *Limnocodium* (*Craspedacusta*) *sowerbii*, a new trachymedusa inhabiting fresh water. *The Quarterly Journal of Microscopical Science* 20: 351-371.

NESTERUK T. 1996. — Density and biomass of Gastrotricha in sediments of different types of standing waters. *Hydrobiologia* 324: 205-208.

NESTERUK T. 2004. — Benthic and epiphytic fauna of Gastrotricha in littoral of mesotrophic lake in Łęczna-Włodawa Lakeland, Poland. *Fragmenta Faunistica* 47 (1): 1-6.

REID J. W. 2001. — A human challenge: discovering and understanding continental copepod and habitats. *Hydrobiologia* 453/454: 201-226.

SCOURFIELD D. J. 1897. — Contribution to the Non–Marine Fauna of Spitsbergen. Part I. Preliminary Notes, and Reports on the Rhizopoda, Tardigrada, Entomostraca & C. *Catalogue of the Birds in the British Museum* 20: 784-792.

TODARO M. A. 2014. — Gastrotricha. Accessed through: World Register of Marine Species at http://www.marinespecies.org/aphia.php?p=taxdetails&id=2078 on 2014-06-20

TODARO M. A., TELFORD J., LOCKYER A. E. & LITTLEWOOD D. T. J. 2006. — Interrelationships of the Gastrotricha and their place among the Metazoa inferred from 18S rRNA genes. *Zoologica Scripta* 35: 251-259.

ZAWIERUCHA K., SZYMKOWIAK P., DABERT M. & HARVEY M. S. 2013. — First record of the schizomid *Stenochrus portoricensis* (Schizomida: Hubbardiidae) in Poland with DNA barcode data. *Turkish Journal of Zoology* 37: 357-361.

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